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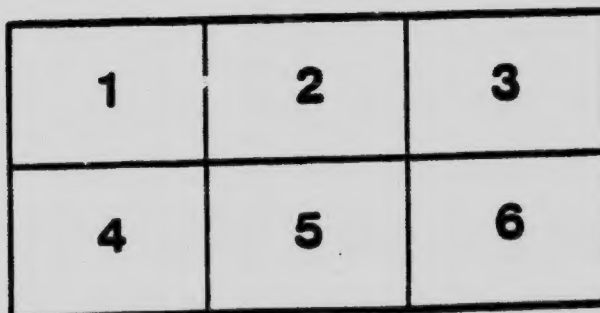
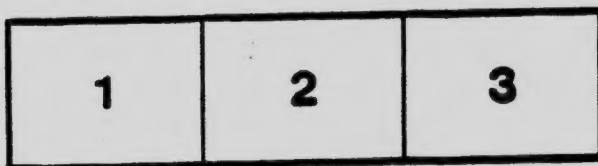
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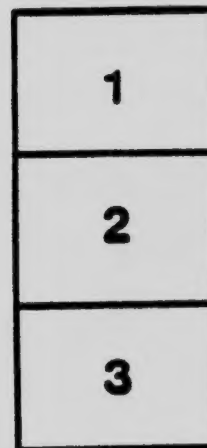
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SPECIAL REPORTS

BY

PROFESSOR EDWARD E. PRINCE, F.R.S., CANADA

*Dominion Commissioner of Fisheries, General Inspector of Fisheries, and Director of
the Biological Stations of Canada.*

I. THE LOCAL MOVEMENTS OF FISHES.

II. UNUTILIZED FISHERY PRODUCTS IN CANADA.

1907



OTTAWA
GOVERNMENT PRINTING BUREAU
1907



SPECIAL REPORTS

BY

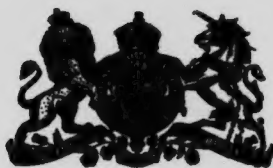
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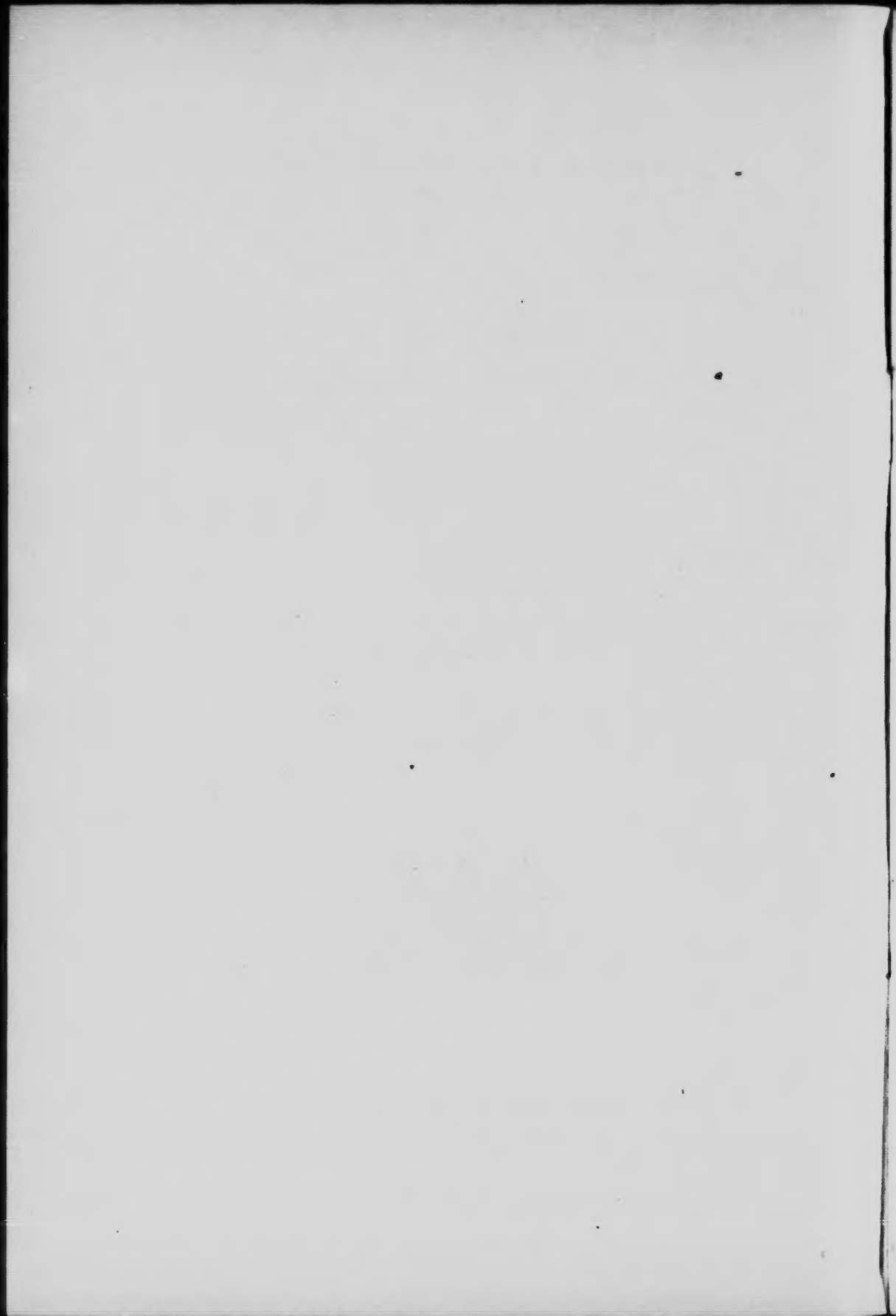
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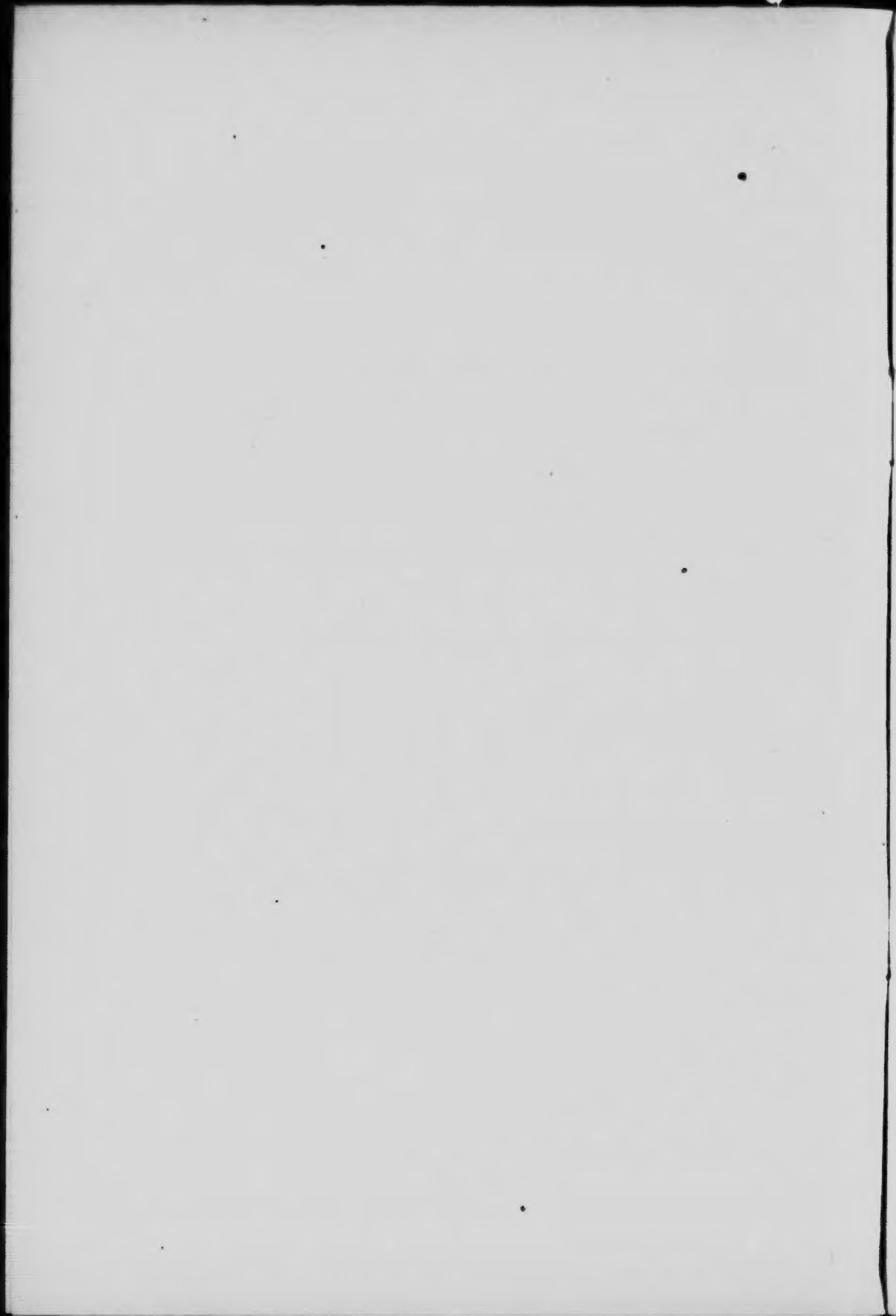
CONTENTS.

I.—THE LOCAL MOVEMENTS OF FISHES.

Alleged uncertainty of fishes' movements—Two supposed causes of migration—Fishes move with fixed regularity—Practical bearing of question—Fry migration—Professor McIntosh's great discoveries—Persistent habits of young fish—Studies on flat fish (plaice)—Marking fish inconclusive—Local varieties imply limited migrations—Fishes are true to their routes—Migrations not always at spawning time—Utility theory inapplicable—Past subsidence of sea important—River basins once part of sea—Hardships of migrating salmon—Many salmon die—Land-locked varieties of sea-fish—Heredity is the cause—Some fishes non-migratory—Summary. pp. 1 to 12.

II.—UNUTILIZED FISHERY PRODUCTS IN CANADA.

Introduction—How products are wasted—Reprehensible methods of utilization—Best products essential—Known neglected resources—Foreign fish products instructive—The carp—Improved methods of utilization urgent—cured *versus* fresh herring industry—Ontario cured herring impossible—Tunny industry possible—Skate, dogfish, shark's fins, &c.—Roe of fishes—Sea cucumber or Trepang—Abalone and other mollusks—New bait resources—Sea-weeds, &c., for chemicals, food, bedding, &c.—Corallines and sea-weeds for decoration—Eel skin industry—Fish and sea-weed glue, isinglass, &c.—Shell, button, and pearl industries—Prawns, shrimps and crayfish—Skins of fishes, whales, &c.—Ice industry suggested—Conclusion. pages 13 to 34.



I

THE LOCAL MOVEMENTS OF FISHES.

BY PROFESSOR EDWARD E. PRINCE, DOMINION COMMISSIONER OF FISHERIES, CHAIRMAN OF THE BRITISH COLUMBIA FISHERIES COMMISSION 1905-1907.

The belief long prevailed, and even now has wide currency, that fishes in the sea, or in lakes and rivers, are somewhat erratic and uncertain in their movements. It was admitted that the migrating schools of salmon showed regularity in the periods of their ascent of rivers, and had more or less fixed courses, while the vast armies of herring, off the British shores, were imagined to move from the Arctic ocean southwards with unerring certainty, skirting the Scottish and English coasts, to disappear in the depths of the sea.

ALLEGED UNCERTAIN MOVEMENTS OF FISH.

These two examples of regular and orderly migration were however held, by fishermen and authorities in general, only to emphasize the general feature of fortuity in the wanderings of the finny tribes, by their exceptional character.

To the scientific mind there appeared something incongruous in this alleged erratic and aimless migration. The order of nature is such that the lives of animated things, even man himself, are circumscribed by conditions and unalterable laws, and the migratory habits of fishes could hardly be an exception. The pursuit of fishing has always appeared one of the most uncertain possible, and this uncertainty in the capture of fish seemed to support the theory that no regular laws, or well-ordered conditions, governed the movements of the inhabitants of the deep.

TWO SUPPOSED CAUSES OF MIGRATION.

Two causes, it is true, were regarded as most potent in stimulating and directing the course of fish, viz.: the search for food, and the search for suitable spawning grounds. But while there is some foundation for this view, yet it will not, in strictness, apply to most cases, for appropriate food is very widespread, and not limited to special localities, omitting certain very exceptional instances, while the discoveries of science in recent years have shown that the spawning process might be appropriately performed in almost any area through which migrating schools of fish may pass.

FISHES MOVE WITH FIXED REGULARITY.

Far from being erratic and wholly uncertain, the migrations of fishes exhibit in general the most astonishing regularity, and so true may they be to their particular migratory course, and to the period or, it may be even said, the exact date of their appearing, that some profound cause is evidently at work; some cause more potent than the search for a favourite feeding ground, or for an accustomed spawning resort. The purpose of this brief report is to show what this profound cause is, and to indicate some of the complex features which modern scientific studies upon fish life have revealed.

PRACTICAL BEARING OF THE QUESTION.

The subject is one of great practical moment, for the determination of wise preservative measures, and of appropriate fishery legislation, and even of far-reaching international fishery policy, depend upon an accurate knowledge of this subject, viz.: the real character of the movements of the schools of fishes in their native waters.

MIGRATIONS OF FRY.

The migratory movements of fishes begin immediately after they leave the egg. In fresh water the young hide in pebbly rough ground at the bottom, and move into smooth sheltered shallows, as soon as they are strong enough to swim with some vigour. At first they are weak, and in most cases swim with difficulty, owing to a large sac of food yolk attached to the underside of the body. In the sea, the yolk-sac may act as a float and the young fish wriggles along in a reversed attitude, back downwards. The fine-meshed tow-net of the naturalist captures immense numbers of these small newly hatched fish which abound within a fathom or two of the sea's surface.

PROFESSOR MCINTOSH'S GREAT DISCOVERIES.

Thanks to marine biologists in Norway, Britain, France, Germany, the United States and Italy, a large mass of information is now available regarding the eggs and early life-history of marine fishes; but no researches compare for extent and value, with those of the famous Scottish zoologist, Professor McIntosh, whose investigations have been recognized in all countries for nearly 30 years as the most important and valuable of all. His scientific reports on fish-life in the North sea, were published in the Royal Commission's Report on Trawling, London, 1884. Professor McIntosh's were the first systematic studies actually carried on upon fishing boats and tugs out in the sea, and in experimental tanks at the marine laboratory, St. Andrews, with the object of deciding the spawning habits, nature of the eggs, character of the young, and their migrations in the sea. These studies have been carried on continuously to the present time.

PERSISTENT HABITS OF YOUNG FISH.

The migrations differ somewhat in various species, but their ascent or descent vertically, or their movement from shallow to deep water or *vice versa*, have been proved to be as certain and unchangeable as the seasonal travels of migratory birds. Storms, winds, &c., may delay or even divert them somewhat, but their courses on the whole are fixed and unailing. Thus the young cod' says Professor McIntosh in a recent address,* the green cod, haddock, and whiting, after their earliest (larval) stage, are oblivious of currents in their movements—on the one hand to shallow, and on the other hand to deep water, and the same may be said of the young flat-fishes. There is no reason to believe that the hardy adults are affected by temperatures, currents, or salinity in a greater degree, except in so far as storms may sweep into bays greater quantities of food.'

STUDIES ON FLAT FISH (THE PLAICE).

The plaice which is one of the most abundant and valuable of European flat-fishes has usurped a large amount of attention since its eggs were first hatched and its stages of growth to the adult condition studied, and figures drawn at St. Andrews, Scotland. Other younger workers have since then published results, in later reports, but they are singularly at variance. 'Dr. Bolan, the German experimenter' as is pointed out in

*Two lectures 'Scientific Work in Sea Fisheries, Royal Inst.', London, May, 1907.

the Royal Institution lectures already referred to,* differs from Dr. Garstang, the former stating that plaice leave the coasts in summer and autumn, and return in spring, whereas the latter gives spring and summer as the period of migration to the off-shore. Here, then, is considerable variation in the results, and neither agrees with the condition at St. Andrews. Many supposed phenomena of migration are found to be outside the regular movements of the fishes referred to, while the alleged scarcity of disappearance of fish, especially in the sea, may be due to defective means of capture, e.g. the beam trawl or an unattractive bait. Certain observers, under the Scottish Fishery Board, reported the disappearance of plaice from their haunts, but as Dr. H. M. Kyle has shown the introduction of a plaice-seine from 1872-1880 in Danish waters trebled the catches in supposed depleted areas. The use of a new bait, viz.: an actinian or anemone instead of the usual mussel bait, revealed the presence of abundant cod and haddock, which were supposed to have declined. The ordinary bait had lost its power to attract them.

MIGRATIONS OF MARKED FISH INCONCLUSIVE.

Experiments with marked fish in the sea have proved most inconclusive. A far safer guide is the course taken by the practical fisherman, whose living depends upon his captures, and seeks the fish where they are. Marked plaice have been found hundreds of miles from the spot where they were liberated. May it not be that like the 'Rat with the bell' in the old story, or the dog with the kettle tied to its tail, these fish carrying an irritating plate, or wire, or other mark, behaved in an abnormal and misleading manner.† The lobsters set free by the United States' experimenters, on the Massachusetts shores, which wandered over a hundred miles, cannot be taken as proof that the vast hordes of Canadian and United States lobsters perform seasonally such extraordinary journeys.‡ We know that the shad enters certain eastern streams on our Atlantic coast, evidently coming in from no very distant places in the open sea, yet the shad planted in Oregon were found to have wandered 400, 500 and even 1,000 miles, two specimens being captured, as early as 1895, at Rivers inlet, at least 500 miles from the place of liberation. Many, too, have entered the Fraser river.

LOCAL VARIETIES IMPLY LIMITED MIGRATIONS.

There is abundant evidence that fish have their own resorts, and adhere to their own migratory courses. An experienced salmon fisherman can readily determine from what river a certain salmon has been taken. A Godbout (Labrador) salmon cannot be confused with a Restigouche fish, or the latter identified with a Miramichi or St. John river salmon. All differ in form, build, average size, &c. Nay, a fish so uniform in size as the sockeye or blueback salmon (*O. nerka*) of the Pacific coast, shows similar local peculiarities. A Rivers inlet sockeye is of larger size, it is claimed, than a Fraser river fish, while the red flesh is paler than that of the sockeye of the Nimpkish river, only 40 or 50 miles away. The Nimpkish salmon average, one important canner said, 16 to a case (48 lbs. weight) though an exceptionally large sockeye was taken in that river, in 1895, for 10½ to 11½ salmon filled a case of canned fish. Further, it is said that in the same river, particular 'runs' make for specified tributaries or upper waters. 'I can tell a Harrison river sockeye,' said a pioneer salmon canner on the Fraser river; yet there are at least seventy-five tributaries of the Fraser river to which

* Lecture II., p. 8, reprinted from the *Zoologist*, 1907.

† In the Lancashire Sea Fisheries Laboratory Report, 1907, p. 128, Mr. J. Johnstone, that in some species the flesh is chafed and a bad wound caused by the marked label.

‡ Dr. Alex. Meek says in his report on 'Migrations of Crabs' that from the records it is shown that 'the males may remain in the same region for several years.' Sci. Invest. Northumb. Sea Fish. Rep., 1906.

the salmon schools ascend for spawning purposes. A similar statement may be made in regard to the sea herring, of which the Loch Fyne variety has long been generally recognized. On the great lakes the common whitefish (*Coregonus*) exhibits distinctive differences in each of these vast areas. All these facts go to show how emphatically local a great many species of fish are, and that even so typical a migratory fish as the sea herring is confined to comparatively narrow limits, the schools in each locality, moving in from the deep water and back again to these feeding grounds, without wandering very far from their native area. There are exceptions to which I shall make reference on a later page.

FISH ARE TRUE TO THEIR MIGRATION ROUTES.

Not only have the fishes, in sea and fresh water alike, their own local habitats, but they adhere very strikingly to their own routes in moving over their restricted areas. It is well known that fish-traps and other nets, set in a particular spot, will make large captures, because the schools habitually pass that spot, whereas a net placed close by, but just off the specified route, will make poor captures or even take none at all. It has long been known, on all salmon rivers, that the schools have a very definite course, and while winds and tides, storms and currents, may cause modifications, these changes are subordinate and do not affect the general law. The English Severn, as I have mentioned in previous reports, possesses tributaries which to all appearance are as suitable as any others, yet the salmon never ascend them. It is true of all salmon rivers. Such a river as the Skeena, in northern British Columbia, has comparatively few tributaries (as compared with the Fraser), but the main schools (i.e., the sockeye salmon) adhere to certain tributaries only and will not go up all alike. Indeed, they prefer the upper Babine tributaries, to reach which frightful canyons, terrible rapids, and every kind of deterrent, must be overcome; but the nearer easier tributaries cannot tempt them to enter. The immense armies of Fraser river salmon, moving along the Juan de Fuca straits, will not turn aside, though numerous suitable and more accessible spawning ground occur on Vancouver island, such as those up Clayoquot sound, &c. As a prominent Clayoquot salmon packer said of the small schools which passed his locality: 'I thought that these fish were on their way to the Fraser and that we only got a wing of these schools that swung into our sound, but the longer I stay there, the more I am convinced that they are peculiar to their localities. They seem to run regularly, and the big (Fraser) run does not affect them, which I think would be the noticeable feature if they were in any way connected with the Fraser river run.* Not only is this the case, but the salmon on reaching the upper waters, when a fork occurs in the tributary up which they are moving, will unfailingly select one fork or branch, season after season. In the Nicola valley there is a salmon stream which divides into two owing to an island in midstream, and across the left channel a barricade was built for lumbering purposes. The salmon could not surmount the barricade, but they would not ascend the right or open channel. The local Indians said: 'The salmon know their way and that right channel is not their channel.' The bands of Indians above could not get their food supplies of salmon and complained bitterly. Certainly in large estuaries like the Bay of Chaleurs, the salmon moving into the famous Restigouche river prefer the southern or New Brunswick shore, and the salmon nets on the Quebec or north side are therefore few, and their catches have always been smaller than on the opposite shore.

MIGRATIONS NOT ALWAYS AT SPAWNING TIME.

While fish, as a rule, move in large schools as spawning time approach† and anadromous species move into rivers yet there are regular migrations, which have not

*At intervals every fourth year is the popular view, the Sockeye Salmon run in exceptional abundance up the Fraser river.

†There are exceptions. The Caspian herring, *Clupea Kessleri*. Dr. Kousnetzoff, says 'remonte individuellement, et non par bancs, le haut Volga, &c.' Rep. Int. Congress Fisheries, Paris, 1900, p. 111.

this purpose. The smelt, for example, is a spring spawner and in March or April deposits its eggs in brackish water near the mouths of rivers and in estuaries, but, in such a river as the Miramichi, immense schools of smelt enter the river in November and December. At that time enormous catches are made through the ice. Indeed the greatest catches of the year are then secured. So far as known there is no particular food at that time to attract them in, and they are not approaching the spawning condition, which is attained four or five months later. Schools of sturgeon migrating from the sea have been similarly observed, long before their spawning period. Fraser river fishermen claimed that they came in after the smelt, in February, and fed upon them as voraciously as the Labrador cod feed upon the smelt-like capelin (*Mallotus*) when these small fish approach the shore for spawning purposes. This early run of sturgeon was in February, 1895; but the great runs of these fish were in the fall in August, and later, when drift nets were used in the night at 'slack water.' Ten or twelve years ago I saw large runs of half-grown pike (*Esox*) passing up small streams in the northern Saskatchewan district, northwest of Canada. They were so numerous that I procured a number by striking them at random with a long pole, and they proved a welcome addition to our camp fare. The descent of eels, in large schools, down rivers is now understood, since it has been proved that these fish spawn in the sea. The young eels 3½ or 4 inches long ascend in spring some weeks after they have hatched out.

Now, while there is ground for the view that winds, currents and tides, and possibly temperature, salinity, &c., may affect the movements of fishes, there is no question that the cause of these migrations is more profound. Nor is it sufficient to say that it is of advantage to the fish to move, that they may escape enemies and other dangers, and that on the principle of the survival of the fittest, the kinds of fish that have adopted the migratory habit have survived, while those succumbed that did not do so. If this be true of the shad or the salmon why is it not true of the eel, whose young are hatched out in the deep sea, in the midst of those dangers which it is alleged the shad and salmon escape by being hatched in fresh-water, more or less distant from the sea? The newly hatched herring mounting to the surface of the sea and moving shorewards later 'to form' as Professor McIntosh says 'a carpet on the sandy bays,' still maintains its amazing plenitude, while the migratory river herring known as the gaspereau or alewife, having acquired the habit of ascending the rivers to escape the sea's dangers, at the time of spawning, has decreased, and in some Canadian rivers has become almost extinct.

The real reason which prompts fish to migrate from deep water to shallow, or from the sea to remote fresh waters, or like the catadromous eel to descend to the sea for breeding purposes, must be sought in less obvious explanations than mere safety, or more favourable physical and biological conditions.

PAST SUBSIDENCE OF SEA IMPORTANT.

The researches of Dr. Oskar Grimm on the fishes of the Caspian sea no doubt furnish the key to the problem. There are five or six species of herrings in that sea, showing, as Dr. J. D. Kousnetzoff says, "l'union qui existait à l'époque géologique très éloignée de cette mer close avec le bassin de la mer Sarmate et prouve son origine commune avec la mer Noire et la mer d'Azow." Moreover, as this authority states, the herring in these seas, now no longer continuous, ascend their respective streams at the proper season to spawn. During the rest of the year they remain in deeper water, where food is abundant. "La plus grande partie de l'année le hareng reste dans les profondeurs de la mer Caspienne," says Dr. Kousnetzoff, "car il s'y trouve une abondante nourriture dans la masse des êtres vivants, commençant par les crustacés et finissant par le poisson menu, *Atherina caspia*, Eichw.

RIVER BASINS ONCE PART OF SEA.

It seems clear that the salmon, shad, alewife and other migratory sea fish, still resort to the regions (the upper waters and chosen spawning sites) to which their ancestors resorted, when these regions still formed part of the sea. As the land was elevated, and the more remote river basins were cut off, excepting by the narrow communications called rivers, the fish retained their hereditary tendency. This tendency, often named instinct, is so strong that all the endless obstacles to accomplishing the migration cannot deter them. Rocky canyons, rushing rapids and falls, landslides filling up river channels, predatory birds and aquatic mammals, fishermen civilized and savage, bears, foxes, seals and all manner of enemies make war upon them. Man erects dams and barriers or pollutes the waters with factory refuse, but the hereditary instinct is too strong to be crushed down.

HARDSHIPS OF MIGRATING SALMON.

The fish take no food, they become emaciated, worn, and injured, and multitudes die on their long journeys, sometimes 1,000 miles or more from the sea. 'The salmon,' said Dr. Tarleton H. Bean, 'would have been better off, it appears, had it never been born in fresh water, where its dangers are cumulative and deadly.' In the sea it is plump, silvery, and free from disease, the areas open to its wanderings are illimitable, it has abundant room to flee from its enemies, and man has sought in vain to net or capture the fish in the open ocean. Yet so uncontrollable is the migratory tendency, hereditarily implanted, that it must perforce move shorewards, seek the mouth of its chosen river, having gained which it ceases to feed, deteriorates, becomes diseased and quarrelsome, and even dies under the harsh conditions of its sojourn in fresh water.

NUMBERS OF SALMON DIE.

In all salmon rivers a proportion of parent fish die from wounds or exhaustion—in some Scottish rivers a considerable number do so; but the opinion has been expressed that in British Columbia, and Pacific salmon rivers generally, no adult salmon survive the migration from the sea; a statement which is without doubt, extreme. There is proof that not all die, and the late Dominion Fisheries Inspector, Thomas Mowat, stated his view (in 1892) that about 25 per cent of the British Columbia salmon runs return to the sea, and the statement is doubtless not far removed from the fact.

LAND-LOCKED VARIETIES OF SEA FISH.

The salmon is certainly a sea-fish, like the shad and gaspereau, and its spawning sites, now far removed from the sea, were once part of the ocean; but have, as stated, been cut off. To reach these ancestral spawning grounds the salmon must migrate; but its return to the sea is not absolutely essential. There are indeed, land-locked salmon. In Scandinavia, Russia, United States, and Quebec and New Brunswick (in Canada) salmon are found which do not migrate to the sea. They might do so in some cases, as in the cases of the Chamcook lakes in New Brunswick, but do not do so. The land-locked salmon of Lake St. John, Quebec, can descend to the sea, but could not return if they did so. Whether now cut off by geographical conditions or not, the hereditary instinct has been lost, just as the domesticated duck has lost its migratory instinct. Such instincts or tendencies are difficult to eradicate, and the hunting, especially the bird-catching tendency of the cat-tribe, is still strongly re-

tained by the domestic cat in spite of its ten thousand years of association with man.* I have elsewhere dealt with the possible modes in which land-locked varieties of sea-fish may have originated. Hence the occurrence of smelt in Loch Lomond, New Brunswick, can be understood, or even their occurrence in lakes in the Gatineau region, far removed from the sea (600 or 700 miles). Hake (*Merluccius*) are known to take to a fresh-water life, and one Gadoid, the Burbot or fresh-water Ling (*Lota*) is purely a fresh-water species, and occurs in the most remote lakes of northwest Canada, as well as the great lakes and connected waters. 'Fishes are not so sensitive to changes of temperature, to change in salinity, or to other phenomena, as supposed; neither do they dread currents.' Professor McIntosh recently pointed out, 'the salmon, the sturgeon, and the eel are at home both in the sea and fresh water, and the flounder, the mullet, the sea-perch, the sprat, and the sparling, take little notice of varying salinities. The Baltic herring can readily be acclimatized to fresh water, even to the extent of being killed, if by accident it suddenly falls into sea water.'

HEREDITY IS THE CAUSE

The migratory instinct is an old, hereditary and deeply implanted tendency, and the surprise is, not that it is retained so strongly in the salmon and similar fish; but that it is ever lost. Just as the migration of birds cannot be fully or satisfactorily explained on grounds of utility, or of intelligent observation and ratiocination, yet is so wonderful that a pair of swallows will leave their nest, migrate across France and the Mediterranean to Algiers, and in the following spring will return, not only to the British islands, or the same parts of those islands; but to the very barn or house, where their old nest is still to be found. The 'homing' powers of pigeons and of cats, indeed all the phenomena of animal migration are to be traced to heredity, and in the case of fishes, can be explained as set forth in this report.

SOME FISHES POSSIBLY NON-MIGRATORY.

There are some fishes which do not, so far as our present knowledge goes, show this pre-determined and fixed character. Such fishes appear to be neither true to an established route of migration, nor confined in their movements within local and limited bounds. The sharks and dog-fishes in the sea are erratic and uncertain, they resemble the wolves, which may infest a district for a time, destroy the deer, and then move to other regions. Hordes of dog-fish, and schools of sharks, seem to have the same erratic hunting instinct. In fresh-water the carp, introduced into Canada twenty or thirty years ago, and the native cat-fishes, appear to have no settled migrations, or fixed geographical bounds. Like the house-sparrow (*Passer domesticus*) they wander everywhere, and make themselves at home everywhere. More accurate studies may show that even the carp has local and regular migratory movements. We know that the whale tribe, long regarded as the wandering monster of the deep, have habitual courses, and move with great regularity along 'beats' which the whalers discover without difficulty. The eel is one of the few catadromous fishes known. It descends to salt water to spawn, though in remote inland waters as in Canada, it may, like the abundant fresh-water gadoid, the burbot or river ling, spawn in fresh water. That remains to be discovered; but the eel, it must be remarked, is a highly specialized and much modified fish, and its habits afford no light upon the general laws of fish migration.

* Cats are found in the tombs of their owners in Egypt embalmed, indeed mummy cats are of common occurrence dating back 10,000 or 12,000 years at least.

SUMMARY.

The importance of the facts dealt with have a direct and vital bearing on fishery legislation, and the difficult problems of appropriate and effective fishery regulations. If valuable food fishes are restricted and local in their habitats and in their movements; if they are controlled by rigid hereditary instincts, that fact will dictate in many ways, the kind of protective measures which will best preserve the fish. The points may be briefly stated as follows:—

1. Young fish in their first stages have a vertical and, later, a horizontal distributory migration.
2. Maturing and adult fish move from deep into shallow water, and do not wander widely, while anadromous species are true to their routes, return to their own rivers, and even return to particular tributaries or spawning sites.
3. Fish schools also migrate when not seeking spawning grounds and probably not in search of food.
4. Heredity affords the best explanation of the remarkable phenomena of fish migration.
5. The existence of local varieties (salmon, herring, &c.) proves that these typical migratory fish do not traverse vast distances, or scatter fortuitously.
6. Few fish are erratic, and such form notable exceptions to the general rule, that migrations are regular, geographically restricted, and under the potent stimulus of heredity.

II

UNUTILIZED FISHERY PRODUCTS IN CANADA.

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The utilization of waste products is one of the most remarkable features of the manufacturing world to-day. The fisheries have been an exception, almost the sole exception among the great industries of the world, and little has been done to turn to account the waste materials and by-products yielded by the fish business. The flesh or muscular tissues of fish and in a few instances the liver, are almost the only portions that are, speaking in general terms, made of commercial value. The head, fins, tail, skin, bones or skeleton, entrails, and various internal parts are usually thrown away and wasted. The amount of offal or 'gurry' and other waste materials produced at great centres of the fishing industries is astounding. But apart from these by-products, which are unutilized, though the waste is fully recognized, there are also vast quantities of materials of value going to waste and unutilized because no one recognizes their value, and few realize that they exist.

It is true that at intervals some venturesome authority announces to the world that sources of wealth are being ignored, and many cases might be instanced of schemes of utilization which are absurd and impossible. The public and governments have been repeatedly led astray through the mistakes or the ignorance of persons, not possessed of adequate practical and scientific knowledge to see the impracticable nature of their schemes. To the ordinary observer, indeed, they may appear feasible, and commendable.

A scheme which aroused much attention a few years ago referred to the utilization of lake herring. It was thought by persons not properly informed that a cured or pickled herring industry might be created on the Great lakes of Canada, and just as Scottish cured herring were in demand, at very remunerative prices in United States markets, so Ontario cured herring could be similarly supplied to these markets. The fatal objection, of course is this, that there are no herring in the Great lakes, which can be cured by the Scottish method. The so-called lake herring are not herring at all. They do not belong to the Clupeidae or herring family; but are really 'lesser whitefish' and belong to the salmon and trout family, which are utterly unfitted for curing in the way suggested. The bones are too few in these lesser whitefish to make a compact salt-cured fish, the flesh is flaky and unsuitable, the flavour is inappropriate, and barrels of such fish shipped to the markets would entail loss upon the shippers. The whole scheme was Quixotic and impracticable.

Every one knows the wonderful story of the utilization of coal-tar products. These were formerly regarded as waste and valueless; but the ingenuity of the late Professor Crace Calvert, of Manchester, England, showed that valuable dye-matters (aniline dyes) could be extracted from the gas-tar. Later, odours or scents, and the most delicate and exquisite flavours, those used especially in confections and sweet-meats, were extracted. Later still, glycerine, vaseline, and numerous oleaginous products were obtained until the waste by-product, the valueless coal-tar has become one of the most valuable materials in modern industrial enterprise. Other cases might be instanced; but it is in the field of fisheries especially that products of great value exist which have not yet been turned to account.

That in important fishing centres where wealth, intelligence, and enterprise abound, there should continue, year after year, the most extensive waste of materials

containing products of importance and value is truly astonishing. The fisheries, indeed, offer a promising arena for investigation in this regard, and this report is intended to direct attention to some of the unutilized materials which are available for utilization in Canada.

HOW PRODUCTS ARE WASTED.

There are three principal ways in which fishery resources of value are going to waste or rather are not being utilized so as to bring adequate returns. First there are products which are being thrown away and got rid of as useless which are of value if properly handled; second, there are products which are being so badly utilized as to bring the smallest returns possible; third, there are products which are not neglected and not recognized as included in our fishery resources at all. There is of course danger in the attempt to place on the market a new product and human ingenuity may devise methods of turning out fish for food which are reprehensible.

REPREHENSIBLE METHODS OF UTILIZATION.

Thus it is well known that for many years past quantities of so-called smoked whitefish and smoked salmon sold in Chicago were not smoked fish, and had never undergone that wholesome method of preservation. These whitefish, probably deteriorated by being kept too long, were chemically treated and coloured by means of aniline dyes so as to resemble in colour the smoked whitefish which is so much in demand. Salmon, too, had been treated in the same way, and the method not only resulted in fish resembling the smoked product in colour, but there was no loss in weight, as there always is during the genuine smoking or semi-cooking process. In January last year the officials on one occasion seized five tons of salmon in Chicago, which had undergone no process of smoking whatever, yet in colour and to some extent in odour they were a good imitation of smoked salmon. A well known United States journal thus referred to the seizure of a quantity of these fish: 'Assistant City Chemist Francis J. Seiter has been analyzing the seizures, and he says that the fish are not only coloured to give them a nice appearance but that it is done because smoking fish reduces the weight while dye adds to it, therefore making a greater profit for the dealer, and a corresponding loss for the consumer. "One hundred pounds of fish which is treated by being smoked will weigh but sixty pounds, after the process has been gone through with," said the assistant city chemist. "If the fish is dyed the loss will be but a few pounds. All of the fluid in the fish is preserved and therefore a big loss in weight is saved. The manufacturers of aniline dye guarantee that 100 pounds of fish treated with dye will not lose more than 20 pounds to the hundred. The loss in weight is always much less than this."'

A good deal has been said, during the last year or two, about the canning of dyed carp and other artificially coloured fish, and their sale in the markets as Pacific salmon. The best markets, such as the London market, to which Canadian canned salmon has always been mainly shipped, cannot be deceived, and will not buy or handle these false products. Where, however, there is an overwhelming population usually on the verge of extreme poverty, there is a sale of such goods; but the good repute of Canadian fish will not permit of the encouragement of these nefarious methods. Our fish packers and dealers must, in their own interest, put only the best food products on the market and thus maintain the reputation and ensure the demand for Canadian fish. Six or seven years ago there was an outcry against certain shipments of fish from eastern Canadian ports, to Porto Rico, and there was actually a protest issued by the Porto Rican Board of Health in 1901 against such fish. 'On many occasions large quantities of cod-fish have been condemned as unfit for use. All the samples,' the board stated, 'were poor in quality and much of it of such low grade that it could not be sold at any price.' The resident British consul forwarded the representations, and

while it must be admitted that there has been carelessness in cleaning and curing many catches of cod and other fish in the Maritime provinces, it is also true that no cured codfish in the world can compare with the Canadian catch on the whole. It certainly compares well with the American catches on the same banks, and our methods are not inferior to theirs. The trouble in Porto Rico, it was hinted, arose from a desire on the part of United States shippers to bring Canadian fish into disfavour, and leave the field open to themselves alone. A similar prejudice was created in Europe regarding canned lobsters, which were reported to be of poor quality, whereas the United States lobsters were graded as of high quality. Parisian and London buyers were frequently impressed by this claim of United States superiority, whereas almost the whole of the United States shipments of lobsters are Canadian lobsters, caught in Canada, and packed here, and shipped to Europe via United States ports through American middlemen and agents.

BEST PRODUCTS ESSENTIAL.

While the above is true, it remains no less imperative that those, who put up and handle fish products in Canada, must maintain a high standard and thus secure, as was the case for many years with British Columbian canned salmon, a better price than that paid for United States and other canned salmon. Fifteen years ago I personally called the attention of prominent curers and merchants in Halifax, N.S., to the absolute necessity of avoiding carelessness in gutting and cleaning fish, and in preventing their undue exposure to the sun, when on the vessels and wharfs. I so reported to the Minister of Marine and Fisheries at the time, and have my report now before me; but one curer to whom I objected that there was too much 'blood' remaining below the backbone, near the shoulders, gave me the reply that the 'negroes of the West Indies preferred strong smelling fish.' The so-called blood is really the decayed kidneys, dark red organs, which are most offensive when they become putrid.

The quality then of our present fish products must be maintained and improved wherever possible.

KNOWN NEGLECTED RESOURCES.

Before referring to industries that can be created by utilizing products not recognized as food products at all by fishermen, I may, in passing, refer to the long neglect of fisheries, of which our people were well aware; but to which they were indifferent. Thus clams which abounded on our Atlantic shores, and eels which ascended in countless millions up our eastern rivers from the sea and grew in fresh water to large dimensions, were for a long period wholly neglected. On the Pacific coast the neglect was even more extraordinary. When delivering an address in the rooms of the Vancouver Board of Trade in 1895, I first called attention to these neglected resources, and the matter was emphasized in certain articles in a Vancouver newspaper from which I culled the following:—

Fish Other than Salmon.

'Two promising developments have marked the fishing industry. One was that the export of fresh fish has been established and with a success that indicates permanency. The other is that sudden attention has been bestowed in the curing of fish and the prospect of securing a market has presented itself. To write a chapter on the fish of British Columbia which would do justice to the subject, would make it too long for the purpose of this article, but to omit all reference to it would be presenting Hamlet with Hamlet left out.

Briefly, without giving scientific nomenclature, the fish most abundant in the coast waters are: Salmon, of which there are about six varieties, not including salmon

trout (*Salmon purpuratus*) which some authorities alleged to be the true salmon and not our salmon of commerce; cod, of which there are several varieties, exclusive of the whiting and 'skil' which belong to the *Gadus* family; halibut, or giant sole, very abundant in northern waters and of great size and fine quality; herring, smelts, sardines, sea bass, flounders, soles (wrongly so called locally), and oulachons. All these are fish of commercial value. A few others, such as Tommy cods, grey lugs and capelin, are offered very rarely. The fresh waters inland contain in great abundance trout, sturgeon, land-locked salmon and species of whitefish. The sturgeon grows to an enormous size, sometimes caught weighing 1,000 lbs. The cod banks of British Columbia have evidently not been definitely located as yet, for while the young cod come into the bays and inlets in large quantities, the parent fish is not caught in sufficient numbers to warrant the belief that his peculiar habitat has been discovered, though it has been fairly well in Alaskan waters.

For four or five years back there has been a conviction in the minds of many that the export of fresh fish to the large centres would pay, and that it would ultimately assume large proportions, but numerous ventures and experiments were made without success, and it seemed as though British Columbia was too far from the market to promote any trade of importance. However, last year several carloads of fresh salmon and halibut were sent to New York, and while the venture did not meet with any great financial success, the result justified further attempts in the same line and this year they have been followed up somewhat energetically. It is the intention of several companies engaged in it to continue shipments throughout the year. Trial shipments of fresh fish, principally salmon, were made to China and Japan, Australia and England, regular shipments being continued by the Alaskan steamers.

There need never be difficulty in disposing of fish products, for there are many countries, which have practically no fish of their own, to which Canadian shipments could be sent if once a systematic scheme were decided upon and properly launched. Four or five years ago Mr. E. E. Sheppard, who had been Canadian Trade Commissioner in Central America, called attention in an address in Toronto to the curious fact that 'while Canada, with its rich and varied fisheries had practically no fish trade with South America generally, yet Germany, which was not a fish-raising or fish producing country, sold large quantities of fish, in various forms, to South America.' A prominent Toronto journal, in a leading article, attempted to deal with the reasons, which appear mainly to be indifference and lack of enterprise, though it remarked regarding Canada that 'the Dominion, probably the greatest fish raising country in the world', sold comparatively nothing in the way of fish to those countries. It is quite likely that the lack of means of conveyance has something to do with the conditions so far as Canada is concerned which Mr. Sheppard points out.

Happily there has been a change during recent years; but South America still offers a great field for fish business.

FOREIGN FISH PRODUCTS INSTRUCTIVE.

Nations like the Norwegians and Japanese have always utilized a vast number of fish products which we ignore. The fact that Canadian waters have produced in unparalleled abundance the most superior kinds of fish, salmon-trout, whitefish, pike, perch, sturgeon, &c., in the inland lakes and rivers, and cod, mackerel, haddock, smelt, herring, lobsters, oysters, &c., in our seas, amply accounts for our indifference to other fish products which are viewed as inferior. In Mediterranean countries, Italy, Spain, Greece, &c., the fish markets abound in edible marine products, which no Canadian ever thinks of eating. The Chinese, Japanese, and our native Indian tribes regard as luxuries many fish and other produce of the waters, which we view as beneath contempt. Just as the Scotch reject shrimps, prawns and eels from their list of table delicacies, while the English regard them as dainties, so the French

esteem the crayfish and certain mollusks, which are not on the Briton's usual bill of fare. A Halifax correspondent, two or three years ago, gave the details in a local paper, and said of his experience at Japanese dinner tables:—

'Other articles which I have eaten in a single full course are fish, soup, fried fish, baked fish, fried eels and rice, pickled eggs of sea urchins, dry octopus or squid, boiled abalone, sea weed jelly and shredded whale cartilage pickled.'

THE CARP.

I have in a previous report dealt very fully with the carp question,* but as chairman of a special fisheries commission, which has been taking evidence, during the last two years, along the waters of western Ontario, I have been once more impressed with the serious nature of the 'Carp Question' in Canada. It is true the fishermen generally view the matter with less alarm for, at certain times of the year the carp are in demand in United States markets, and bring remunerative prices, especially as the fish increase in numbers very fast and grow rapidly to a large size; but carp will never be a popular article of diet in Canada unless put up in some appetising form. The fishermen themselves, who capture carp, confess that they do not eat these fish, they much prefer good whitefish, lake herring and pickerel or doré. When smoked the German carp acquires a dainty flavour, and a tempting appearance. It appears that a large new industry could be created with a little enterprise by sending these fish into the market. The carp are split open, cleaned, sliced into long thick strips and soaked in salt and water for about twelve hours. The brine should not be too strong, a little experience enables the curer to judge of the right quantity. The salted or pickled strips are then placed in a smoke-house or smoking receptacle, laid out on a frame over a fire. Maple chips, corn cobs or other agreeable smelling combustible material may be used for the fire, and by placing the frame on which the fish is spread 18 to 24 inches from the fire, the heat and smoke partly cooks and smokes the fish at the same time. Care must be taken that the fish do not acquire a disagreeable black colour, as in the case of some sample shipments of smoked carp sent to the Buffalo markets the black colour was objected to. If the fish are properly smoked there is no objection to the adoption of an artificial yellowish brown dye or stain such as burnt-sugar fluid, which will give them a more appetising colour. Smoked sturgeon is regarded by epicures as one of the finest of edible fish products, and smoked carp has been declared by experienced Ontario fishermen as equal to sturgeon so prepared. There is no doubt that smoked carp would bring a much better price than ordinary fresh carp, the price of which during a part of the year is very low.

IMPROVED MEANS OF UTILIZATION URGENT.

There are many fish, which by a slight process of curing can be made to yield far larger returns than when sold fresh. Had Scotland shipped all herring in a fresh or slightly salted (semi-cured) condition to Germany, Russia, or other countries, to be there converted into other food products, there would never have been built up the great Scottish herring industry of to-day—one of the most profitable and important fishing industries in the world. On the Atlantic coast, Canada ships, in a fresh condition, vast quantities of half-grown herring (called sardines) to the so-called sardine canneries in the State of Maine. The value in 1905 was nearly \$700,000; but had these fish been manufactured and packed in Canada the value would have been about ten times as much.† Canning on a small scale is now proceeding in New Brunswick, the

* The place of carp in fish culture. Supp. I., 29th Annual Fisheries Report, Ottawa, 1897.

† The value of this U. S. sardine industry ranges from \$5,000,000 to \$7,000,000 per annum.

value in 1904 being \$32,000 (for a pack of 604,200 cans); but in the future this industry, involving the employment of a large amount of labour, the building of machinery, making of cans, &c., will no doubt develop on our own shores just as the lobster canneries have grown on the same eastern shores to be a vast industry.

CURED VERSUS FRESH HERRING INDUSTRY.

A similar loss of business has continued for many years on the Pacific coast.* British Columbia firms have exported in a fresh or semi-fresh (slightly salted) condition, immense quantities of fine herring to the State of Washington to be utilized there either in kippering or as bait or as fertilizer.

This export of herring as raw material brings the poorest returns, and the province of British Columbia would receive one hundredfold returns were these herring cured, or kippered, or canned in the Dominion, or sold as bait direct to the fishing boats at Canadian ports. As United States citizens have been mainly active in encouraging in British Columbia, and carrying on under the auspices of British Columbia firms this herring export, the greater interests of the province were not, of course, recognized; but the limitation of this inferior and less remunerative traffic is the main means for cultivating a profitable and important British Columbia industry comparable to that of Scotland. The Scottish herring curing experiment, carried out at Nanaimo by the Dominion government, in accordance with my recommendation, has proved that British Columbia herring can be converted into a cured product not less valuable than the esteemed Scottish herring. Several important British Columbia firms have already built sheds and wharfs, and commenced Scottish herring curing operations, with the possibility of large developments in the future.

A Victoria newspaper in 1906 emphasized this great possibility, and called attention to the growth of a canned herring industry on the Fraser river, the supplies of fresh fish being obtained at Nanaimo:—

'The Windsor cannery of New Westminster is taking daily consignments of several tons to the Royal City, where they are being canned and shipped to the eastern market. So great are the orders for fish besieging local establishments that it has been found necessary to put on a night shift, and while a very large force is working in these establishments there is a standing advertisement in the local papers for assistants in preparing the fish for market. Judging from the present outlook, the fishing industry here promises to develop in importance subordinate only to mines.

Yet while this utilization in Canada of fish caught in Canadian waters was thus being energetically started and developed, a serious leakage was at the same time going on, on an extensive scale, viz., the shipping of vast quantities of fresh herring, or very slightly, but not really cured fish, to Seattle and Tacoma, to build up a rival curing industry just across the line, thus competing with our infant industry, with a view to its destruction. I quote again from the same journal:—

'The herring industry in Nanaimo is now in full swing. The fish are running in a constant stream as never before witnessed this season and the curing establishments are working 24 hours a day with a large staff filling orders that have been on file for months back. There are now no less than three steamers making semi-weekly trips to Seattle and Tacoma with fresh herring. The *Ranger*, *McCullough* and *Squid* are the vessels employed, each of which carry from seventy to a hundred tons a trip. Captain Fulton of the steamer *McCulloch*, which cleared yesterday for Seattle, loaded to the water line, says that an enormous market for local consumption is being built up in Seattle. Now that Seattle people are being introduced to the delicacy of Nanaimo herring, the demand is growing steadily. From other parts of the state of Washington

* The late A. R. Milne, C.M.G., customs collector, Victoria, B.C., said in 1895: 'There is not a systematic herring fishery in the whole Pacific coast, yet the Sandwich islands want them.'

orders are also coming in for Nanaimo fish, so that this avenue of the herring industry is proving a profitable one for those engaged in it. Just now, Seattle dealers are placing Nanaimo fish in cold storage so as to be in a position to handle outside orders.'

ONTARIO PICKLED HERRING IMPOSSIBLE.

As all experts are aware, there are limitations to the curing and canning of fish. All fish cannot be satisfactorily cured or canned, and many mistaken projects have been urged by persons lacking in knowledge and experience. Thus, the scheme set forth in Ontario four or five years ago that a Scottish herring industry could be created on the great lakes was most absurd, for two reasons:— (1) The so-called lake herring are really lesser whitefish, and will not stand curing in the way the herring will, with its very numerous bones holding the flesh well together. (2) The trade would refuse to accept as herring an unsuitable pickled fish such as the small species of whitefish, mis-called by all the fishermen, lake-herring. For the same reason, viz.: the nature of the flesh and bones, the smelt cannot be satisfactorily packed in tins. The smelt, like the so-called lake herring and the whitefish are salmonoids, and have more of the nature of the salmon and trout than the herring or sardine, hence experiments tried in New Brunswick were not satisfactory. On opening a can of smelts the meat was found to have fallen from the bones and had a dry 'jumbled' appearance and far less appetising than the compact neat-looking sardines, though the flavour was excellent. The delicious candle-fish or oulachon of the Pacific coast, like the smelt, is not suitable for canning, though the United Empire Salmon Co. way, with ample capital proposed to experiment in the northern British Columbia waters in putting up canned oulachons. The best method is pickling and preserving in kegs, though if nicely put up in long narrow bottles in vinegar or other preserving fluid, they might be a success in the markets. As the flesh adheres loosely to the backbone it falls off in 'chunks' when cooked and canned.

TUNNY INDUSTRY IMPOSSIBLE.

No one acquainted with the great Tunny fishery of the Mediterranean, or familiar with the flesh of that fine fish when placed on the table, can doubt that, if the large specimens of the Tunny (*Thynnus thynnus*) caught every season on our Atlantic coast could be preserved and marketed, a demand would spring up for it. Its importance in France is next to the sardine, as M. Pierre Lemy, a preserved food merchant in Paris said, 'Après la sardine le thon (tunny) est, en France, le poisson qui est l'objet de la fabrication la plus importante dans le genre d'industrie dont nous nous occupons ici. La majeure partie du thon pêché dans le golfe de Gascogne est capturée par les pêcheurs bretons ou vendéens qui ramènent leur poisson dans les ports où existent des usines de sardines, sûrs qu'ils sont d'y trouver l'écoulement de leur butin. La plupart des usines de sardines fabriquent, en effet, du thon conservé.' —(Paris Exhib., 1900, Memoires, Congrès International d'Agriculture et de Pêche, p. 359).

The mode of putting up the flesh of the tunny may be briefly stated:—The fresh fish deprived of the head, tail, fins, and entrails, is cut into large pieces and boiled in salt and water. After thus being cooked, the pieces are dried in chambers through which passes a strong current of air through numerous openings. The dried portions are cut down to appropriate sizes, placed in cans, covered with olive oil, sealed hermetically, and boiled in retorts like sardines. The tunny being allied to the mackerel, has a good flavour and is in high favour where its qualities are recognized. They are called mackerel sharks in mistake, also horse-mackerel, in Canada, and excepting that the Gaspé residents have been accustomed to salt a few in barrels at times they have been usually thrown away and wasted when captured by the fishermen. I have

seen them rotting on the beach at Yarmouth, N.S., and in Gaspé basin, P.Q. Smoked tunny, and bonito, really a smaller species of tunny, are popular in Japan. As Sir Frederick Nicholson says, it is an excellent product, 'economical in use, and will keep good for years.' The same authority informs us that the fish after being opened and boned is cut into longitudinal strips, boiled or steamed, dried on trays in the open air and then smoked over a slow-combustion furnace which burns various woods and sawdust. A dozen or more trays are piled up so that the smoke penetrates the various tiers, and colours them a dark brown, after which the fish is given a final drying in the open air or in a drier at 70° to 90° F.

SKATE, SHARK, DOG-FISH, SHARK'S FINS, &c.

Skate, sharks and dog-fish are abundant, too abundant, the fishermen think, in Canadian seas; but they have been little utilized. I dealt fully with certain phases of this matter in my former report on 'The Dog-fish Pest in Canada,'* and since then the Dominion Government have attempted in three different localities. Shipigan, N.B.; Canso, N.S., and Mud island, N.S., to utilize these fish, particularly dog-fish for fertilizer and oil. In my report I referred to the edible qualities of the dog-fish family, and on recent visits to Boston I found in that fastidious city that some prominent fish-dealers' stores exhibited choice cuts of a firm white fish labelled 'ocean whitefish,' which was no other than the dog-fish (*Acanthias*) of our waters. It was regarded as very good by those customers who had tried it. The central part of what is called the 'wings,' i.e., the large breast fins of the skate are regarded even in England as a delicacy by epicures, and skates' 'wings' find ready sale. The Chinese have always held sharks' fins, &c., in esteem. In the *Norsk Fiskeritidende*, February, 1907, pp. 50-55, is a short article on these dried fins and the Chinese and Japanese markets, with an illustration on page 51, showing how the fins require to be neatly cut off at the base and hung, after being salted, to dry. Of eight species of sharks and dog-fishes generally utilized, four at least occur, or almost identical species occur, in Canada, viz.: *Carcharias*, *Alopias*, *Lamna*, and *Mustelus*. The dried fins are sold by the picul (133½ lbs.) i.e., about 16½ piculs to the English or 'long' ton. The price varies according to quality, but may be as much as 50 cents per pound (\$70 to \$80 per picul). They are largely handled by Messrs. Aagaard, Thoresen and Co., Hong Kong, British China, and there is no limit to the market. India, especially the Madras Presidency has largely exported shark's fins to China. Shark and dog-fish paste is also a commodity in demand, especially in Japan. The flesh removed from the boxes is pounded into a paste, a little salt being added, and it is made into rolls, like rolls of butter, which are steamed for nearly half an hour. These rolls of a lard-like appearance will keep for several days, even in hot weather, and it is in general use. The flesh of sharks and dog-fish has long been a staple article of diet in New Zealand and the Southern Pacific islands, and if these fish, captured in Canadian waters, could be supplied to these natives, a considerable demand could be created. The Maoris capture the fish by means of baited hooks.

Fresh mullet is the one bait a shark finds irresistible and will always bite at, but where this is not to be had a very good substitute, and a bait sharks take is the large six-inch mussel, which is to be found in numbers on the submerged sand-banks of the coast.

Great quantities of these shell-fish are collected in readiness ere the season commences, and being placed in heaps on the beach.

But before commencing fishing operations a large loosely woven flax receptacle, containing the pelt and offal of some slaughtered animal, a bullock or a sheep is hung

* The Dog-fish Pest in Canada.' Special Report, Mar. and Fish. Report (Fisheries), 1903.

over the boat, the blood and savour of it filtering through render the sharks perfectly ravenous. Dozens of them flock around the floating bag, making ineffectual snaps at it as the man holding the line jerks the tempting morsel from their jaws. In the clear water every motion of the fish can be watched, and their rushes at the bag avoided.

The baited hooks are suspended near the bag and considerable catches are made, especially of which are called ground sharks.

Blue-shark, shovel-nose, and hammer-heads are all caught in numbers by the natives, and all are found equally good eating.

None of these species, however, attain a size of over twelve or fourteen feet in length; indeed, the average run of size is from six to eight feet. The flesh of the larger fish is said to be too coarse and strong-flavoured, and the fishermen accordingly discard anything over ten feet long.

The carcasses after being cleaned, are hung in the sun to dry upon transverse poles supported by uprights 20 feet high, and in three or four weeks they are cured, and dry as wood. They are then packed in flax mats and transported in bales to the various native villages. Dried shark has ranked high as an article of food amongst these Pacific natives. The smaller sharks or dog-fishes and their allies, the skates and rays, are, however, better adapted for table use in civilized countries, being superior in texture, colour and flavour, and if properly cleaned, the entrails and skin carefully removed, and the flesh prepared in small 'chunks,' there is no reason why it should not become a general fish food, like the once despised flounders and flat-fishes, the sea cats and frog-fishes, which now readily find sale in the best European fish markets.

ROE OF FISHES.

The eggs or roe of fishes is chemically a nutritious material and caviare, or the prepared roe of the sturgeon is one of the most esteemed and expensive of fish products. The public indeed have made such a demand, especially in the United States, for certain fish containing well developed roes, that the price of fish like roe shad, in Fulton Market, New York, last season, sold at 35 cents each, while shad not containing roe brought 15 cents. At Boston and New York restaurants the cooked roe of a shad costs 75 cents to the retail customer. But roes of fish other than sturgeon or shad have a value as food, though so generally wasted and thrown away with the entrails, as gurry on the great lakes, splendid caviare has been made of the roes of suckers, pickerel or dore, and other fish, by enterprising fish merchants. Such caviare if coloured with some harmless dye should rapidly become a recognized and profitable commodity. The most important demand, in many respects, for fish roes is, however, for use as a lure or bait for attracting and collecting the wandering sardine schools. Just as 'pummy' proved effective in the mackerel fishery off the Atlantic shores, so preserved 'roe' or 'rogue' is valuable in the sardine netting operations. Norway has a most remunerative 'rogue' industry, and Newfoundland has provided a good deal though on account of poor packing it is sought less eagerly than the Norse cod roes. The United States also produces this article. The well-developed eggs of the cod, haddock, mackerel, hake, pollock, &c., are best for the purpose. The roes are carefully removed entire, salted and packed tightly in barrels. They are repacked later in barrels through which holes have been bored one-quarter inch in diameter. The brine escapes through the holes and the roe is preserved in a dry condition. Dr. Hugh M. Smith, in a most interesting report (United States Fishery Bureau Bull., 1901), gave the details of the industry, and points out that the eggs must be separable, that is, well formed, the salting must be carried out while the egg mass is fresh, being placed in layers of dry, rather fine, salt, and after the first packing, should be repacked, graded according to quality or state of ripeness, and finally packed in barrels holding 308 to 316 pounds weight. Loose eggs or broken roes must be packed separately.

There have been spasmodic attempts to supply the demand for 'rogue' or cod's roes cured in a way suitable for the European sardine fishery, and amongst many references in official reports, I quote the following from a Dominion fishery officer's report about twenty years ago, in which reference is made to the preparation of cods roes on the Gaspé coast:—

'Cod is a delicious fish, and one in which there is no loss. It supplies human food, oil and a kind of glue which is as much prized as that of a sturgeon. Large profits are also realized from the sale of cod roes. The preparation of this article, which yields a large revenue to Newfoundland fishermen, was until lately comparatively unknown to our people; but I notice with pleasure that more attention has been paid to this branch of industry than usual. Four or five years ago the Gaspé people began the preparation of cod roes for export, but, for reasons unknown, the trade was dropped. Having plenty of time on hand this season, they again set to work, and the statistics show that on the coast of Gaspé no less than 622 barrels of cod roes were prepared, giving a revenue of over \$4,000. Newfoundlanders export this article to Norway and France, where it is used as bait for sardine fishing, and sells from \$5 to \$8 a barrel.

'Codfishing on our shores is divided into two seasons: summer and fall fishing. Formerly, the only fish that were dried and went to the merchants were those caught after August 15. The fish caught after that date were salted and sent to Montreal or Quebec in barrels, or were traded for the purchase of winter provisions. But now that almost everywhere in Gaspé, and especially in the western part, the system of engagements is changed, there is so to speak but one season fishing, the summer fishery; since all the fish caught is dried for export.

'Although cod is met with on the whole coast of Gaspé, there are several places where it is found in greater abundance than others, such for instance as Percé and the neighbourhood of Bonaventure island and of Cape Gaspé. In these places also the fish remains a greater length of time than at others.'

Along the Mediterranean, in Japan, China and other eastern countries, the large masses of eggs, orange coloured or reddish, which are contained in the sea-urchins or prickly sea eggs, abundant on our Atlantic and Pacific shores, are sold in the markets as food. They are esteemed as highly as oysters, and as sea-urchins are so very plentiful, they might be turned to account if pickled and shipped in jars, like jam, to the countries where sea-urchin's eggs are an article of diet.

The suggestion has been made that the eggs of dog-fishes and skates, which are obtained in great numbers when these fish are being captured and utilized, might be made of some use. When the dog-fish are being handled at the Government Fish Reduction Works, these eggs (like the large eggs of birds removed from their shells) may cover the wharfs to a depth of several inches. They are most excellent and nutritious food. In my former report on the Dog-fish, I mentioned their use in Scandinavia in the making up of puddings, and recently an eminent English chemist, Dr. T. E. Thorpe, in an official report to the Cornwall County Council, emphatically states that:—

'The eggs of the dog-fish, when boiled, are very similar to an ordinary hard-boiled hen's egg, and a wholesome and highly nutritious food.'

THE SEA-CUCUMBER OR TREPANG.

The trepang is an esteemed article of food in China. It is really the dried sea-cucumber—a large kind of sea slug or echinoderm*—often 12 to 15 inches or more in length and 3 or 4 inches in diameter. These creatures abound on the Atlantic and Pacific coasts of Canada, and may be taken with ease by means of a dredge; yet, so far as I am aware, this abundant food product has never been turned to any

* Often called 'beche-de-mer.'

account by our people. Their preparation is very simple, and when dried they sell in Canton for \$45 or \$50 per ton. It would cost little to gather them, and as they would find a ready and lucrative sale amongst the Chinese and especially, if shipped to China, that it is surprising no firm has ever entered into the business.

The late Judge Swan, who noticed the abundance of sea-cucumbers or holothurians on the coasts of Vancouver island and Queen Charlotte islands showed some specimens to several Chinamen, who at once declared them to be the best quality of 'whetong,' one of the Chinese names for trepang. The trepang, when prepared for market, is an ugly looking, brown-coloured substance, very hard and rigid, and can be eaten only after being softened by water and a lengthened process of cooking, when it is reduced to a sort of thick soup by the Chinese, who are very fond of it; and when cooked by a Chinaman who understands the art, it makes an excellent dish.

The preparation of the trepang for market is simple. They are to be boiled in water, either salt or fresh, for about twenty minutes, and then slit open, cleaned, and dried. Those dried in the open air or sunshine bring a higher price than those dried over a wood fire, which latter is the usual process adopted by the Malays. Some varieties require boiling for only a few minutes, or till they become firm to the touch. They must be dried thoroughly, as they absorb moisture readily, and are then liable to become mouldy and spoil.

Europeans who have tried trepang report that it is very good, and if the trepangs after being gutted are boiled in a decoction of 'artemesia' it is said to be preferable to the salt cure. They should be spread on a bamboo frame and dried in the sun. New Caledonia, the Pacific isles, Malay, the Ladrões and the New Hebrides supply great quantities; but when dredging in southern New Brunswick, and in various regions in British Columbia, it was often difficult to haul up the dredge on account of the mass of writhing, slimy, sea-cucumbers gathered in the bag.

ABALONE AND OTHER MOLLUSKS.

The abalone, which occurs in the northern waters of Vancouver island, and off Queen Charlotte islands, is valuable both as food and for its beautiful pearly shell.

The massive fleshy body of the abalone or ear-shell (*Haliotis*) is salted, boiled and dried, and is in great demand in China. It is often slightly smoked, while the shell is used in the manufacture of buttons and for ornamental purposes. A long spear may be used in fishing for it from an open boat though the Japanese fishermen in California and in British Columbia obtain it by diving. A water glass for searching the rocky haunts of this shell-fish is usually brought into requisition. Sir F. A. Nicholson refers to a fishery on the Madras coast and states that the shells alone exported to England during the ten years, 1890-1900 realized nearly \$13,000.

Quite a number of shell-fish could be turned to commercial account in Canada, British Columbia alone producing 16 or 18 different kinds, of which only two or three are utilized. The razor-clam has come into demand in many American cities; but the demand for these shell-fish boiled and dried is enormous in China. Extensive cultivation of these shell-fish is now carried on in Japan.

The pecten or scallop is an esteemed shellfish, which in Canada has largely gone to waste, although used to a small extent for bait. A recent writer, describing the scallop dredging industry of Long Island and the method of marketing them, says that in the opening of the clam shells and removal of the flesh, the children of the fishermen are mainly employed. 'A small boy or girl will open a gallon of scallops in one hour and ten minutes, and receives from twenty-five to thirty cents per gallon, according to the size of the shell, large fish filling a measure much quicker than small ones. An expert adult will open two gallons an hour. As it takes two bushels of scallops to yield a gallon, an enormous amount of shells has to be handled. The emptied shells are thrown in piles outside each house.

The average catch for each boat is thirty-five bushels a day, but when scallops are plentiful a boatload has been known to result in one hundred bushels. A large percentage of those taken are seed scallops, and there is need of reform in this respect. They are better for eating after they have spawned, and as the average number of eggs laid by a seed scallop is one hundred thousand, each one destroyed, though only twenty per cent of those spawned might live, means a loss to the industry the following season.

'After being opened the scallops are thrown into water to soak until time for shipment, and here is a "trick of the trade" not generally known. Soaking scallops in water causes them to swell, and in this way a shipper can increase the bulk of his shipment nearly half. Five gallons freshly opened will increase to seven gallons by this process; and it is rumoured that they are sometimes soaked over again by retail fish dealers. This soaking process whitens them, but it takes away their sweetness and fills them with water to such an extent that frying them crisp and brown is almost an impossibility.'

The pecten or scallop, like the cockle and the mussel, is a tough attractive bait, as well as an esteemed table delicacy a portion of which may be prepared like stewed oysters, or served as a soup of the richest and most appetizing character. Great beds of pectens exist, though not generally known, on both our Atlantic and Pacific coasts. They have hitherto been practically unutilized.

NEW BAIT RESOURCES.

Cockles and mussels are of market value in most countries. Boiled and dried, the Chinese regard them as a delicacy, but cockles are now coming into demand in United States cities and amongst Canadians. There is no more dainty or delicate food. Vast areas on the Atlantic and Pacific shores, could be made to yield quantities of mussels, and in view of the great demand in Scotland for these shell-fish for bait purposes, it might be remunerative to ship them to the British islands, where they have sold for \$5 to \$10 per ton in the shell. Holland exports immense quantities to London and to Scotland, and it is a most profitable business. At St. Andrews, in New Brunswick, the extensive sand flats there are yielding remunerative catches of cockles. The St. Andrews *Beacon* some months ago said:—

'The cockle business is assuming quite respectable proportions in this locality. This season (1906) a number of men found lucrative employment in gathering these shellfish from the beaches, the local price being 45 cents per bucket. The largest exporters say their shipments this season will total up over 2,400 buckets, and they have many orders that they will be unable to fill, owing to scarcity of men. The cockles are shipped direct to the haddocking fleet at various points on the New England coast. They are used entirely by the handliners. Linefish like cod and pollock are very fond of this bait, while the dogfish have no liking for it. In using it the fisherman breaks the shell off and then pounds the meat into a pulp, otherwise it will harden and choke the hook. Each fisherman is provided with a hammer and a small piece of flat iron (the latter being set in the vessel's rail) for this purpose. The demand for this kind of bait is steadily on the increase. It is worthy of remark that this is the only locality west of Portsmouth, Mass., where cockles can be found in paying quantities.'

Other bait products are whelks, anemones and lampreys. The last-named fish abound in certain Canadian rivers and lakes. The Dutch fishermen have long found the lamprey cut into pieces, a most durable and successful bait, and the Thames fishermen sell about \$4,000 worth per annum to the Dutch fishermen for that purpose. They have bought from the Thames fishermen \$3,000 to \$4,000 worth, while the Yorkshire fishermen, at Scarborough and Whitby find lampreys one of the best baits for turbot. New baits are often found to vastly increase the catches in long-line, or 'trawl-line' fishing. Lampreys are also said to be a good food; but their use will probably never be general on the table. They might, if tried, prove most effective in sea fish-

ing, and possibly hand-line fishing and in sturgeon fishing in fresh waters. A change of bait has frequently most unexpected results. Professor McIntosh has said: 'Careful observations . . . have demonstrated that in their season, and by the use of anemones for bait, and then of gill-nets, cod (said to be so rare) can be caught in hundreds by a single boat.* Again, the same authority refers to the 'substitution of anemones for mussels, of cuttle-fishes or squid for herrings, of lobworms for scallops, and of the alternation of gill-nets with tempting bait of various kinds. Few appreciate the revelations made by such changes of method.'†

SEA-WEEDS AND MARINE VEGETATION.

'Sea-weeds,' wrote Mr. P. L. Simmonds, 'are used directly for manure, for the manufacture of soda, iodine, bromine, and some like Irish moss for the manufacture of *gelose*. Dried, they are used for ornamental purposes. In many northern European countries, sea-weed is used in winter for feeding horses, cattle and sheep, and it is eaten by deer when other food is scarce. Last year United States Consul Rasmussen, of Stavanger, referring to the handsome returns brought by the sea-weed harvest in southwest Norway, who calcined it and sold the ashes to British agents, pointed out the valuable chemical products yielded, including iodine, and added, this remarkable statement:—

'As a source of income, adds the consul, sea-weed has in a very few years surpassed fishing and agriculture in fortune building. Old debts have been paid off, and land that was formerly unproductive has been drained and filled.'

Of course the amount of iodine is said to vary in the sea-weeds from the different coasts; but whether these plants on the Canadian coasts are rich or poor in iodine can be decided only by tests. In Britain and France, where iodine manufacture is an old industry, the amount of iodine produced by a ton of kelp (kelp is the weed burnt into hard, dark coloured masses or cakes) is 10 lbs., and 20 tons of fresh wet weed makes a ton of kelp, Simmonds stated that 400,000 tons of sea-weed were necessary to yield the annual production of iodine in Britain.

Mr. Rasmussen has afforded much detailed information upon the Norwegian sea-weed industry, and the following may be quoted:—

'The annual income (in Norway) from sea-weed ashes amounts to about \$107,200, but it can be doubled. Every fisherman knows the difference between alga and tang. Only the former can be used as raw material for the iodine and chloriodic industry: tang is entirely worthless. But of the different kinds of alga, it is immaterial, or nearly so, whether one makes use of the large, strong stalks or the broad-leaved kind; when the weed is carefully handled, one can secure an excellent product. If tang is burned with alga the value is decreased considerably, and all such wares should be refused. It is defrauding the purchasers, who might as well buy wood or coal ashes as those burned from tang. This has not been clear to the producers, which is only natural when it is remembered that there has not hitherto been produced sufficient ashes to supply the demand, and the product, therefore, has been partly bought without criticism by the manufacturers.

Besides being mixed with 'tang,' the ashes are often found to be adulterated by sand and stone. Alga ashes are also of little value when decayed or rotten weed is used or when the weed has been too long exposed to rain before dried, or when the fire is extinguished by salt water. The best product is obtained, as a rule, from the cut weed, but weed that is washed ashore is often very good, especially early in the year—say, in April and May.

The weed must be fresh dried and burned on rocky ground. Should it rain the weed must be gathered in a heap and covered. Along with the dry weed must be

* Scientific Work in the Sea Fisheries, London 1907, I., p. 11.

† Id. II., p. 3.

placed some that is damp, to prevent the fire from breaking through, so that no more air is admitted than necessary to promote the carbonization. The burning should take place on rocky ground, so that the ashes will not become polluted with sand and gravel.

We strongly recommend sea-weed burning and careful handling of the product, because Norway cannot afford to lose any of its industries. Now that the Japanese have also entered this field, the price of iodine in November, 1905, fell from 29.65 kroner to 16.95 kroner per kilo (\$3.61 to \$2.06 per pound). What difference the price of the prepared article has on the maintenance of this industry one can understand.

The price is governed by several factors. What we can do is to produce good and sufficient raw material for the benefit of our maritime population and our manufacturers by careful handling of the weed. As an example of how necessary it is and how the question of success or failure is dependent on the quality of the raw materials, it can be mentioned that of two competing manufacturers in this country in the production of the same amount of goods, one used 420 tons of ashes, at a cost of \$13,060; the other used 286 tons, at a cost of \$8,040. This difference of \$5,020 in cost of manufacture represents a direct loss for Norwegian industry, and therewith for our nation; loss caused by carelessness and want of judgment. If the struggle for maintaining Norwegian and Scotch industries stands face to face with Japan—and it will come, and come soon—the best chances for success lie with the factory producing the most economically.

One of the most prolific fields for the growth of sea-weed is at Joderen, on the southwest coast of Norway, where it appears as veritable forests of trees from five to six feet in height, with stems as thick as ropes and as tough as leather. The weed sprouts in summer and gradually covers the ocean bed with a dense brush. In the fall the roots release their suctionlike grip on the rock bottom and great quantities float ashore, forming a sea wall many miles along the beach. The fall crop is good only for fertilizer, and is used as such by the natives; but in spring what drifts in is successfully gathered, dried and burned, and during this season thousands of the farmers who own strips of the coast line make thousands of bonfires, some burning as much as 3,000 kilos a year. This is one of the natural resources of Norway about which little was known 20 years ago. During the summer many train loads are sent to Stavanger, whence two or three cargoes a week are shipped to Great Britain. Subsequent use and treatment are to some extent scientific secrets, although the kelp ash is known to be largely used in the making of iodine. The fact that the industry is profitable is shown by the willingness of the English agents to pay a good price, and many of the Norwegian farmers have become rich by selling it. Modern machinery, in the shape of mowers, hayrakes and harrows, have replaced the primitive farm implements in use a few years ago.

In order to keep their Glasgow, Scotland, plant fully occupied, the British Chemical Company, of Clydebank, are encouraging the revival of the kelp industry in the outer Hebrides. Encouraged by the success which has attended their efforts in Tiree, North and South Uist, Benbecula and Barra during the past three years, the company has extended its operations to Lewis and Harris. Nearly £3,000 were distributed in the Island of Tiree alone last season, and considerably more to kelp makers in the other islands mentioned.

The amount of exertion involved in gathering and burning the tangles is light and the average family can earn £1 per day. If a sufficient quantity can be obtained from the Hebrides the company will not continue to get an additional supply from Norway and Ireland.

The common bladder wrack, *Fucus vesiculosus*, is said to yield more saline and earthly matters than most seaweeds, and Pereira found in it nearly 20 per cent of common salt, 12 per cent of potash, the same of soda of lime and nearly 25 per cent of sulphuric acid. A ton of weed yielding 320 pounds of ash would afford 2½ pounds of

phosphates, iron and lime, 5½ pounds of potash, and other mineral matters, totalling up to over 23 pounds of valuable saline products. Again, as vegetable food many weeds are valuable. The Irish moss (*Chondrus crispus*) is nutritive and emollient and furnishes a jelly valuable in lung complaints. It is dried, bleached by five or six separate exposures to the sun and alternative washings, until it is yellowish white, when it is stored, packed in barrels and shipped to the buyers, which include cooks (for puddings, blanc-manges, &c.), brewers (for clarifying beers), calico printers, paper makers, felt and straw hat manufacturers, &c. Hingham, Mass., U.S.A., at one time shipped large quantities of this so-called sea moss. Dulse (*Scherzysmenia edulis*, Grev.) sold in a semi-fresh condition is in great demand in seaport towns and also inland, and is often eaten with butter and fish, or boiled in milk with rye flour.

Vast quantities of weed are exported to China from Japan and other countries, where it is used as a substitute for dried fish, or as a vegetable, to thicken soups.

The tubular stalklike portions of the large tangle weeds were long used by British Columbia Indians as oil bottles for the storage of oulachon grease, a method of utilizing the hollow rounded proximal part of the plant which the New Zealanders and the Polynesians generally adopted. The most remarkable use of the dense somewhat rubberlike stalks is their conversion into a form of preserved fruit. Lemon peel, orange peel, and citron, have long been used in the boiled, candied form, but the tubular fleshy stalks of the huge laminarian seaweeds have been prepared in the same manner. After the extraction of the sea water and salt, the stalks, cut into pieces of suitable size, are boiled in sugar, and prepared in an appetizing way so that in appearance, flavour, texture, indeed, in all the essential qualities, this 'candied seaweed' is equal to and almost undistinguishable from candied or preserved citron. As a food it is no doubt more nutritious and beneficial than citron, and if the preparation of this seaweed in Washington State, U.S.A., prospers, a great Pacific industry may be developed. Thousands of tons of raw material are going to waste on the British Columbia coast for the giant tangle may range there from 15 to 30 feet in length. Simmonds says that 'Upholsterers and others use seaweeds for stuffing couches, stools, &c., in which they too frequently are substituted for horse-hair. They are used to stuff mattresses, especially for children, because the aromatic odour keeps away insects. Packers use them for wrapping fragile objects.' The same authority refers to the barnacle weed (*Zostera marina*) used for stuffing beds and chairs in France and England, being known as *crin vegetal* in the former country and 'alva' in the latter country. In 1873, Granville, France, exported over 4,000,000 pounds of this dried weed. The annual value was over \$10,000. On the south shore of the St. Lawrence there has for many years existed a similar industry, great quantities of the *Zostera*, or *herbe à barnache*, or 'Pherbe à outarde,' are annually harvested, especially below low water mark, where scythes are used to cut it under water, from boats. Along the shore of Kamouraska, Rimouski, and along the coast of Cacouna, Isle Verte and Trois Pistoles, this rooted goose-grass or barnacle grass grows abundantly. It is thrown up between tide marks after storms, and the long slender fronds may be 5 to 12 or 15 feet in length. Considerable shipments are sent by rail to United States mattress makers, and the residents make profitable returns. A similar dried weed industry could be created along a large part of the Atlantic coast where this weed grows abundantly.*

CORALLINES AND SO-CALLED WEEDS.

Amongst the materials cast up by the sea on flat beaches, beautiful feathery bunches of what are called seaweeds are abundant. They often have a coralline appearance and are much harder in texture than most true weeds. They are not indeed weeds or plants at all, but colonies of minute animals. These colonies may be slender

* It is estimated that the value of this industry at Isle Verte alone ranges from \$10,000 to \$30,000 per annum. (See Inspector Belliveau's Report, Fisheries Report, 1905, p. 81.)

and feathery, or flat and leaflike, but they have a crisp and somewhat velvety feel. In the Channel islands and on certain small islands in the South of England, these so-called weeds more correctly called Hydroids or Zoophyte colonies, are gathered for commercial purposes. On the Isle of Grain it is said that 20 to 30 tons are gathered by the local people between October and the end of March. It is in demand for trimming hats, and quite a demand has been created for it. It is gathered on the sea beach, shells and other matters removed, and after being picked over it sells for about \$250 per ton, London being the principal market. A recent writer says of this little known industry:—

'The "weed," as it is known locally, is not cultivated in any way, but drifts ashore and is picked up upon the beach and foreshore at low tide. Exactly where it comes from does not seem to have been definitely ascertained. Some of the inhabitants are of the opinion that it grows in the deep waters of the North Sea, and others think that its native place is in the shallow waters of the Thames estuary. Be that as it may, the Island of Grain is the only part of the coast upon which it comes ashore in marketable quantities.

'Harvesting the weed provides a precarious and uncertain employment for practically the whole poorer class population of the island. Each gathers for him or herself independently, and disposes of the result to dealers, who in turn forward it to London and foreign houses. A northerly gale brings most seaweed ashore and a single gleaner has been known to pick up half a hundredweight in a morning. At other times, when the wind is in the wrong direction, none will come in for days. The present market price of the partially dried sea-weed, from which all rubbish has been removed, is about sixpence per pound. It must be remembered, however, that the weed is extremely light and feathery, so that a pound, when dried and prepared for use, represents a considerable bulk, and, in the ordinary course, much labour in picking.

'Queen Alexandra, whose antipathy to the ruthless destruction of birds for the sake of their plumage is so well known, has done much to bring sea-weed back into popular favour as an adornment for hats by recently purchasing a quantity for that purpose. When skilfully blended and artistically arranged in combination with artificial flowers, the fairy sprays of this slender and charming sea-weed are capable of producing exceptionally fine effects. In fact, hats so trimmed form quite a feature of some of the famous West End establishments at the present time, and bid fair to become increasingly popular in the near future. The scope of sea-weed for decorative purposes is, however, by no means confined to millinery. It can be purchased in a variety of shades at a moderate figure from most large drapery establishments, and will be found most useful for table and room decorations generally. Great care must be exercised if it is to be used near candles or other naked lights, as the dressing used to preserve its fluffy appearance sometimes renders it highly inflammable.'

On the Atlantic and Pacific shores of Canada these beautiful and delicate zoophyte fronds are found in abundance and wonderful variety. The utilization of materials so easily gathered and capable of being turned to such ornamental and profitable account, must surely occupy the attention of some enterprising pioneer.

EEL SKIN INDUSTRY.

Of all unlikely products any form of leather from a skin or integument so thin and elastic as the skin of eels would appear the most improbable. Yet for many years, in a quiet street near the famous London Bridge, an eel-skin factory has carried on a paying business. There are prepared and manufactured various articles from the integument of the river eel.

The skins are manipulated by numerous complicated processes until they resemble and would easily be taken for leather, although of a more gelatinous and

pliable nature. This strange commodity is cut into long thin strips and pleated very closely together for whip lashes and to cover portions of the handles of more expensive whips. Certain kinds of lashes and harness laces are also made of eelskin.

The leather is almost indispensable in articles of this description, where flexibility, allied with an uncommon toughness, is desired.

GLUE, ISINGLASS, ETC.

It is strange that with an abundance of raw materials there has never developed in Canada a successful fish glue business. Properly carried on, with sufficient technical knowledge, it is a most profitable industry. Fish skins all contain more or less glue of great value. Great business firms like Messrs. Marcus Ward & Co., in Ireland, use weekly many tons of fish-glue; and the demand is enormous. Cements for crockery &c., like 'seccotine,' are used in every household. Codfish skins, hake, &c., could be got in illimitable quantities, while the sharks and dog-fishes are also a source of glutinous materials. Isinglass is a refined and special form of glue made from the swim-bladder and certain internal membranes, especially of sturgeon, cod, hake, &c. These materials have been wasted, excepting by far-seeing United States buyers, who have bought dried sounds of such fish as the sturgeon and turned them into the valuable commercial product referred to—yielding profits of not less than 10,000 per cent. Other fish yield isinglass, indeed last year the Canadian newspapers announced that at Digby in Nova Scotia certain United States firms were inquiring for the raw 'isinglass' material, stating that:—

'The isinglass factories of Gloucester, Mass., are ordering large quantities of hake sounds from those dealers who make it their business to cure that commodity. Shipments are going forward quite freely via Yarmouth.'

The pickerel or wall-eyed pike, the river cat-fishes, the drum-fish, and certain sea-snappers yield the membrane or air-bladder from which glue and isinglass is extracted by soaking and pressure. As a recent authority rightly observes:—

'Glue manufacture provides an outlet for the profitable use of much waste in dressing dried codfish. This material was formerly discarded as useless, but now tens of thousands dollars' worth of choicest glue for postage stamps, court plaster, adhesive paper, labels, envelopes, for mechanical purposes and for sizing of straw goods and textile fabrics, and likewise office and domestic mucilage are manufactured from fish skins. The product is very much stronger and more durable than glue made from the skins of mammals.

'Isinglass made from the sounds or swimming bladders of sturgeon, hake, cod, squeteague, &c., is used for clarifying fermented liquors, the cellular construction forming a sort of net which carries down floating particles.'

In Japan sea-weeds of the genera *Gelidium* and *Gracilariopsis* are used for glue, and for imparting lustre and stiffness to textile fabrics, and glue products of this kind could be prepared in Canada.

SHELL, BUTTON AND PEARL INDUSTRIES.

Many years ago my attention was called by Professor Mavor, of the University of Toronto, to the value of shells, such as the large fresh water clam shells, which abound in the lakes and rivers of Ontario, Manitoba and the west. Many of these shells (*Unio*, *Anadonta*, &c.), are probably too thin usually for profitable utilization, but there are great supplies of suitable shells going to waste, which could be turned to profitable account. The importance of shell products in the United States is apparent from Mr. C. H. Stevenson's statement that 'nearly, if not quite, 1,000,000 tons are secured annually in the United States, consisting principally of the shells of oysters, clams, river mussels and a very much smaller quantity of other varieties. A

fair valuation of these at the places of consumption would doubtless amount to \$1,500,000; to this should be added about \$600,000 as the value of pearls secured during the last year in the Mississippi Valley and elsewhere. The value of the shells secured outside of the United States, principally mother-of-pearl shells, amounts to \$5,000,000 or \$6,000,000 annually, and the pearls secured sell for nearly an equal amount. Pearls are not secured in the seas in such large quantities as formerly, but their value is greatly increased. The manufacture of mother-of-pearl and sweet-water shell in the form of buttons, buckles, knife-handles, pistol stocks, &c., gives employment to nearly 10,000 persons in this country, and to probably three times that number in Europe and elsewhere.

'The shell trade,' said Mr. Simmons thirty years ago, 'is growing year by year into greater importance, and there is ample scope yet for its extension with profit and advantage, alike to the fisherman, the merchant and importer, to the manufacturer and vendor, and to the general public who are purchasers. Leaving out of account the cuttle shell or cuttle fish bone which is obtained from certain species of squid and is used by bird fanciers on account of its calcareous properties, the shells and shell substances found in seas and rivers may be classified as follows:—

- (1) Shells suitable for white and pearl buttons.
- (2) Shells used for ornamenting jewel cases, fancy boxes, and pearly or iridescent in appearance.
- (3) Shells used for knife handles, spoons, lamps, pipes, &c.
- (4) Shells adapted for cameo carving, bracelets and jewellery.
- (5) Shells which can be converted into an enamel for pottery glazing.
- (6) Shells used purely as ornaments when polished or as money amongst primitive tribes.

In Canada our shell resources have been left almost unexploited while certain waters in the United States owing to the demands for their shell products have been almost denuded. One authority of prominence in Iowa has sounded recently a warning note. According to the *New York Fishing Gazette*, February 23, 1907, this authority 'is seeking to get fish commission experts or other qualified experts of the government to make a study of how best to propagate and distribute these mussels or clams. He believes in this way some means can be found to perpetuate the supply and save the industry.

'Census figures show that in 1905 the value of the fresh water pearl button made in the United States was nearly \$5,000,000. Of this amount New York was accredited with \$1,813,167, while Iowa had \$1,500,940. Iowa had fifty-one factories, while New York only had twenty-six.'

The abalone or ear-shell industry is one capable of development, for beds of these beautiful shells occur at known points in British Columbia, and many undiscovered beds doubtless exist. London imports from Japan from 75 to 100 tons of these ear-shells (*Haliotis*), while in California a valuable business has long existed. The following notice of this industry may be quoted, having reference particularly to the fishery on Terminal island, California:—

'When the season is at its height twelve to fifteen tons of abalone are handled each week. They are taken from the shell, the intestines removed, and the muscles boiled for canning and shipped to many points, or dried by steam preparatory to the use of the Japanese, Chinese and other Orientals.

'When the fish are removed the shells are saved. If imperfect, they are stowed away to be ground up for poultry food or for fertilizer. If perfect they are turned over to the California Pearl Manufacturing Company and from them are made some of the most beautiful ornaments that could be imagined.

'Some are polished in their entirety and are sent to the curio and shell stores by the thousand. Many are shaped for brooches, belt pints, cuff buttons, ear-rings, &c., and in their changeable rainbow hues, varying with each angle at which the light strikes them, form most beautiful and attractive novelties. Others are shaped for

settings for jewellery and large quantities are mounted in sterling silver for jewellers all over the country.

'The process of treatment is very interesting. First, the rough exterior is ground on the carborundum wheels. Next they are polished on the cloth wheel and later shaped for whatever purpose is desired.

'The market for these products is ever widening. They are sold from Maine to Tampa and from coast to coast. It is a beautiful product and seems destined to increasing popularity.'

The mother of pearl material when coarsely pulverized is used for ornamental decoration, especially letters in decorative sign painting.

In fishing shell-fish for the various purposes referred to the fisherman has always before him the possibility of finding pearls or gems of value.* Not only the true mother of pearl shell, such as the *Meleagrina* or so-called pearl oyster of Ceylon; but numerous other shell-fish yield pearls, the Chinese river mussel being well-known in this respect. The fresh water muscels, the sea-oyster, the West Indian strombus, the giant *Tridacna*, and many others produce pearls, while in the streams of Britain, especially Scotland, pearls have long been sought in the river clams or muscels; but our Canadian lakes and rivers abound in shell-fish, which are known to produce these valuable gems. Some of our remote waters have recently acquired fame on this account. The *Chicago Examiner* said, a few months ago:—

'PEARL FISHERY IN CANADIAN WILDS.

'In the mighty streams flowing through Ungava, Canada, a profitable pearl industry is carried on among the Indians and Eskimos, says the *Chicago Examiner*. Barrenness and desolation, rocky shores beaten by an icy sea, long winters and short inclement summers are the chief characteristics of that northern land. Signs of human life are scarce there, but at intervals may be seen rude huts of rocks erected by whale and seal hunters long since departed for more profitable fields. In the rushing waters of the streams, which empty into the sea, pearls are found hidden in the shells of the muscels, which are often so plentiful as to partially block the river. Unlike the pearls of Ceylon, they are snowy white, but nevertheless of the finest quality, although a certain percentage are irregular in shape.

At the present time several hundred men are engaged in systematically hunting for the pearls. They collect the muscels and pile them in heaps, where they are left until decomposed and then the pearls are easily extracted from the shells. Several large jewellery houses send travellers on periodical visits to buy these pearls, and, of course, the Hudson Bay Company's traders get a fair share of the gems.'

It is impossible in this place to deal in detail with such branches of a shell-fish industry as the pearl business, or the utilization of the shells themselves; but it may be pointed out that empty shells have a value in oyster culture. They form the best 'cultch' or rough flour on which oysters can be planted for breeding purposes. Quite good returns are secured from the empty shells, which are useless for buttons or other purposes. Scallop shells are in demand and they bring rarely less than 6 cents per bushel.

PRAWNS, CRAYFISH, ETC.

In the future the utilization of shrimps, prawns, and other crustaceans will no doubt be carried out on an extensive scale. They are abundant on the Atlantic and Pacific coasts, and on the latter coast, our Canadian waters abound in a variety of exceptionally fine edible species. A limited prawn and shrimp fishery is pursued;

* It was announced recently in the press that a pearl obtained in the Miami River, Ohio, sold for \$2,800 this season.

but the development of a canning industry would enable these dainty 'shell-fish' to be sent to markets all over the Dominion. In Florida and in California canned shrimps and prawns form an important article of trade.

The incredibly abundant supplies of lobsters on the Atlantic coast of Canada rendered unimportant the creation of a shrimp or prawn fishery; and they still form an unutilized fishery resource.

In our fresh waters there occur numerous species of small fresh-water lobsters or cray-fish, often erroneously called 'craw-fish,' whereas the 'craw-fish' is a very large crustacean found in the sea and resembling a lobster of unusual size, and of a spiny exterior. Few streams or lakes in Canada do not abound in cray-fish; but there has hitherto been little or no demand for them as a marketable product.

Professor E. A. Andrews recently dealt pretty fully with the crayfish question and the possibility of a future crayfish fishery. He says:—

'The demand should increase, with the growth of cosmopolitan populations that appreciate such food as is used in Europe, with the growth of large populations too remote from the sea coast to obtain fresh sea food, and with the increasing inadequacy of the marine crustacea to supply the needs of even those consumers who dwell near the coast. Thus the lobster industry has been strained till the use of young specimens as food to take the place of the exterminated large ones has become very extensive.

'No doubt in time the demand for crayfish will exceed the natural supply and this industry will tend to run the same retrograde course as that of the lobster, oyster, clam and many more important fisheries till the real value of the crayfish as food warrants legislative control and scientific aid such as alone make possible the continuance of more and more of our once "inexhaustible" food supplies.

'Sooner or later the supply of crayfish will need to be made greater. In addition to legislative restrictions and control, three lines of work suggest themselves as suitable for trial when the supply becomes deficient, or, if one is to profit by experience in other fisheries, now, before the supply becomes deficient—first, the artificial breeding of native species in the market region; second, the introduction and propagation of better species than those naturally occurring, and third, the improvement in size and flavour by culture and cross-breeding.

'Experiments in the laboratory have shown the practicability of rearing crayfish artificially. They grew to a length of four inches in three years, and were of marketable size—three inches—at the end of the second year from the egg. The proportion of crayfish reaching maturity was better than might be expected in such cases, and from proper culture large individuals and large races might be obtained.

'The large western Oregon lobster is of rapid growth and grows under artificial conditions to a length of between two and three inches in five months from eggs hatched in the spring. This large species sells for twice the price of the eastern or the southern varieties, and besides its larger size and weight it has the advantage of a more attractive and lobsterlike appearance, so that its introduction into the east should be most acceptable. In fact, the specimens brought here and kept alive in the laboratory were as long as the six-inch "short lobster" now used as food, and if these crayfish were available in quantity they might be used as a substitute for such young lobsters and thus protect the lobster industry.

'The third method of increasing the available food supply—the origination of larger races—may remain for later stages of the industry, but considering the number of species of crayfish in this and other countries, the chances would seem good for some future production of new forms from crossing and selection.

'Apropos of the matter of introducing the Oregon variety into the east, it is interesting to know that a similar thing is going on in Europe. In Germany, France and Switzerland, where the crayfish has been a standard article of food for hundreds of years, the native varieties have been eaten up, and the governments are now stocking the streams and preserves with the American species.'

In Canada the supplies of crayfish are so great that the main question is not how to improve them in size or quantity, but how to turn to account the abundant supplies which we possess.

A shrimping or prawn industry involving the use in most countries of a peculiar small meshed bag or net pushed or dragged along the sandy or gravelly shores where these creatures live is a danger to more valuable fish. Great quantities of small fish of the best kinds are wastefully killed. The Japanese used an ingenious trap which is most effective and avoids all danger to other fishes. It is really a bamboo cage. At the entrance is a funnel-shaped piece with its smaller end projecting into the interior, so that any shrimp that has once entered it can not again get out. When being used, dozens of these traps are tied to a long rope, and crushed shell-fish (*Corbicula* or *Paludina*) are put within each; then the whole is sunk to the bottom. They are taken out from time to time and the shrimps are secured.

CRAYFISH GASTROLITHS.

Two peculiar button-like stones are formed in the fore part of the stomach of the crayfish during the late summer, according to M. Chantron, about forty days before the shedding of the shell. In old times these gastroliths, or stomach stones, or 'crab's eyes,' as they were called, were held in great repute as a remedy against various disorders, and in China and Japan almost miraculous properties are still attributed to them. They bring a very high price owing to their alleged curative properties. These limy buttons are not to be confused with the hard teeth of the 'gastric mill' or hind masticatory portion of the stomach, and their purpose appears to be to provide calcareous matter for the new shell. After moulting these stonelike buttons are found in the stomach and in three or four days they are dissolved and absorbed, and it is stated that unless they are absorbed the crayfish dies from the moulting process. In a large crayfish the gastroliths may be half an inch in diameter, about one-third of an inch in thickness, and are of a smooth chalky substance, chiefly carbonate of lime, with some lime phosphate, a little soda and a proportion of animal matter. Each of these rounded buttons is attached at the side of the stomach in its anterior part. Were a crayfish fishery developed, the collection of these gastroliths in the late summer would be remunerative, as frequent inquiries are made by Japanese agents for information as to where small quantities can be obtained in Canada.

SKINS OF FISHES, WHALES, ETC.

It is impossible in this report to dwell upon the somewhat complex and varied uses of the skins of fishes and aquatic animals. The skins of the porpoise, beluga or white whale and similar sea creatures, can be converted into the finest kinds of leather. The late Campbell McNab, of Portneuf, exhibited extremely fine samples some years ago of beluga leather, which was fine-grained, flexible, unbreakable and most durable. As Mr. C. H. Stevenson, the eminent specialist upon the subject of the utilization of marine resources, has said:—

'Leather is made from the skins of practically all the aquatic animals, and of most of the species of fish, but these rank among novelty or fancy leathers. Seal leather is produced in large quantities. The hide of the beluga, or white whale, is one of the best of all skins for leather purposes on account of its durability, strength and pliability. It is sold as porpoise leather. Tanned walrus hides, especially the thick ones, are in great demand for polishing wheels and other mechanical purposes. Among the aquatic skins used to a less extent for leather purposes may be mentioned sea lion, porpoise, sea elephant and a very large variety of fish skins, especially those of sharks.

The soft elastic skin of the whale and porpoise tribe, rich in gelatine owing to the abundant connective tissue in it, can be pickled as a delicious food. It is one of

the most prized dainties in Greenland and is pronounced excellent by those who have partaken of it.'

ICE MANUFACTURE.

It may not appear very pertinent in a report on fishery products in Canada, which are not utilized, to make any reference to such an industry as the production of ice. There is, however, an appropriateness in introducing here this matter, not only because those engaged in the fishery business use ice very largely; but they are located, as a rule, where the development of an ice manufacturing industry would be easy and profitable. The abundance of ice along our Canadian shores on the Atlantic invites enterprise on the part of fish firms on a more extensive scale than it has hitherto reached. Large cities in the United States, such as New York, Boston, &c., require an almost unlimited supply. There is no duty on ice, and small shippers might find it profitable to ship cargoes late in the winter before warm weather begins, although if shipped in the usual way the cost of freight is too heavy, viz., \$1.50 per ton to New York. Last year and the year before, New Brunswick and Nova Scotia schooners carried single shipments of 150 or 200 up to 500 tons. There is considerable waste (about 40 per cent) under present conditions of transit; but if the United States demand be favourable, there are substantial returns to small shippers who can freight ice at cheap rates on schooners.

CONCLUSION.

In the foregoing notes, which do not pretend to be more than a rapid survey of salient features of this important question, the waste of valuable fish by-products, the production of oil, and the manufacture of fertilizer or manure has been omitted. Two reasons afford an explanation of this omission, viz.: the extent of these questions which is so great that lengthy reports on each would be necessary, and second, the fact that oil and fertilizer industries are already being carried on, perhaps to a very inadequate extent; but on a sufficient scale to show that the value and importance of these waste products are not being ignored in Canada.

